Abstracts of Bell System Technical Papers Not Appearing in this Journal

A Note on the Thermionic Work Function of Tungsten.[1] C. DAVISSON and L. H. GERMER. It has been pointed out that the authors in a previous paper [2] had neglected to apply a correction for the "Schottky Effect" to their results. The present note applies this correction which is found to be comparatively small and does not materially affect the results given before. A fuller discussion of the interpretation of the work function measurements previously reported is also included in this note.

The Action of Fluxes in Soft Soldering and a New Class of Fluxes for Soft Soldering.[3] R. S. DEAN and R. V. WILSON. This is a report of basic studies of soldering fluxes undertaken by the authors. It was found that the fluxing action depends on the evolution at soldering temperatures of HCl gas or other halogen acid gases which have been found to be effective soldering fluxes. Based on this discovery soldering fluxes have been found among the organic compounds and the way opened for the development of a truly non-corrosive flux.

Certain Topics in Telegraph Transmission Theory.[4] H. NYQUIST. The author gives results of theoretical studies of telegraph systems which have been made from time to time. Among other things he points out that although the usual method of determining the distortion of telegraph signals is to calculate the transients of the system an alternative method is based on the steady state characteristics. For the first method the telegraph wave is taken as a function of t and for the second as a function of ω. A discussion of the minimum frequency range required for transmission at a given signaling speed is also included in the paper.

Experiments and Observations Concerning the Ionized Regions of the Atmosphere.[5] R. A. HEISING. Experiments are described in which a virtual height of the reflecting ionized region was measured using time lag between radio signals arriving over a direct and the reflected path. Heights were found of 150 to 400 miles with vertical move-

[1] *Phys. Rev.*, Vol. 30, pp. 634–638, Nov. 1927.
[2] Davisson and Germer, *Phys. Rev.*, Vol. 20, 300 (1922).
[3] *Indus. and Eng. Chemistry*, Vol. 19, No. 12, pp. 1312–1314.
[4] Presented, A. I. E. E., February 13–17, 1928. *A. I. E. E. Jour.*, Vol. XLVII, No. 3, pp. 214–216, Mar. 1928.
[5] *Proc. I. R. E.*, Vol. 16, pp. 75–99, Jan. 1928.

ments at rates as high as 20 miles per minute. Other experiments and curves are mentioned which show absorption to be one of the important factors causing poor daylight transmission for wave-lengths around 214 meters. A discussion is given to show that both electromagnetic waves from the sun and β particles must be assumed to produce ionization to explain radio transmission phenomena observed.

The ionization is pictured as beginning at an altitude of about 16 miles and extending upward, and as experiencing diurnal and seasonal variations. The electromagnetic or day ionization occupies a wide region, and is fairly steady except for the diurnal variation. The β particle ionization which is the principal ionization at night occurs continuously. It is, however, less dense than the other ionization and is very variable.

Diffraction of Electrons by a Crystal of Nickel.[6] C. DAVISSON and L. H. GERMER. The scattering of electrons by nickel has been reported on recurrently since 1921. This paper gives the latest results which indicate that a wave-length is in some way connected with the electron's behavior. A rather complete summary of the experiments and conclusions appeared in the *Bell System Technical Journal* for January, 1928, which makes unnecessary a fuller account here.

A General Operational Analysis.[7] W. O. PENNELL. The paper outlines the elements of a general operational analysis. Using p as the symbol for an operator, the author, starting with a general typical defining equation such as $p(ax^b) = \psi(a, x, b)$, proceeds by definitions and theorems to demonstrate the use of operational methods in a large variety of common mathematical operations.

Precision Determination of Frequency.[8] J. W. HORTON and W. A. MARRISON. The relations between frequency and time are such that it is desirable to refer them to a common standard. Reference standards, both of time and of frequency, are characterized by the requirement that their rates shall be so constant that the total number of variations executed in a time of known duration may be taken as a measure of the rate over shorter intervals of time. Frequency standards have the further requirement that the form of their variations and the order of magnitude of their rates shall be suitable for comparison with the waves used in electrical communication.

Two different types of standard which meet these requirements are

[6] *Phys. Rev.*, Vol. 30, No. 6, pp. 705–740, Dec. 1927.
[7] *Jl. of Math. and Phys. of M. I. T.*, Vol. 7, No. 1, pp. 24–38, Nov. 1927.
[8] *Proceedings of the I. R. E.*, Vol. 16, No. 2, Feb. 1928.

described. One consists of a regenerative vacuum-tube circuit, the frequency of which is determined by the mechanical properties of a tuning fork. The other is a regenerative circuit controlled by a piezo-active crystal. Means are provided, in the case of each standard, whereby the recurrent cycles may be counted by a mechanism having the form of a clock, the rate of which is a measure of the frequency of the reference standard.

Data taken over a period of several years with a fork-controlled circuit show that, under normal conditions, its rate may be relied upon to two parts in one million. Data taken over a much shorter time with crystal controlled oscillators indicate that they are about ten times as stable.

Plane Waves of Light. II. Reflection and Refraction.[9] THORNTON C. FRY. This paper extends the study of plane light waves, which was begun in the *Journal of the Optical Society* for September, 1927, to the phenomena of reflection and refraction. It develops the general formulæ for reflection from a plane boundary between two media and for reflection from thin films, paying especial attention to the situations under which "hybrid" polarization occurs. The differences between the reflected and refracted components in the case of dielectrics and metals are illustrated by a number of diagrams.

The paper closes with a discussion of the determination of the optical constants of metals, both from the state of polarization of the reflected light and from the direction of emergence of the ray transmitted through a prism.

Propagation Characteristics of Sound Tubes and Acoustic Filters.[10] W. P. MASON. This paper describes a method for making acoustic propagation measurements, and presents the results of attenuation and velocity measurements of straight tubes and acoustic filters. The ordinary electrical transmission measuring circuit is employed in conjunction with loud speakers and acoustic resistance terminations. The process of measurement consists in obtaining the transmission characteristics of the systems with the device to be measured in the acoustic circuit, then obtaining the characteristics with the device to be measured taken out of the acoustic circuit. The difference between these two measurements gives the transmission characteristics of the device to be measured between the two acoustic resistance terminations. Results obtained from these measurements for straight pipes agree well with the Helmholtz-Kirchoff Law.

[9] *Journal of the Optical Society of America*, Vol. 16, pp. 1–25, January, 1928.
[10] *Physical Review*, pp. 283–295, Vol. 31, No. 2, February, 1928.

Brittleness Tests for Rubber and Gutta-Percha Compounds.[11] G. T. KOHMAN and R. L. PEEK, JR. An insulating material compounded of rubber, gutta-percha, or of similar substances becomes brittle at a temperature, characteristic of the material, below which it may not be used if liable to mechanical stress. This paper describes an apparatus designed to determine this temperature by giving the sample a sharp bend through a fixed angle. The highest temperature at which fracture occurs in this test (the brittle temperature) is found to be nearly independent of the bending angle and the sample's dimensions provided the rate of bending is maintained at a nearly constant (high) rate. A modified form of the apparatus is also described with which the brittle temperature may be determined when the material is under high hydrostatic pressure. The constancy of the brittle temperature when determined under different conditions suggests that it marks a change in the structure of the material.

[11] *Ind. and Eng. Chem.*, Vol. 20, pp. 81–83, January, 1928.